

anticipated by *Hsu et al.* (U.S. Patent No. 5,707,889). Applicant respectfully traverses this rejection in asserting that the claimed invention sets forth features which are patentably distinct over the prior art of record at least for the following reasons. Reconsideration and withdrawal of the rejection is earnestly solicited in view of the reasons advanced hereinbelow.

The claimed invention is directed to a method of fabricating a semiconductor device including, *inter alia*, steps of:

- (a) forming a silicon oxynitride film on a silicon substrate;
- (b) performing a heat treatment while keeping a surface of the silicon oxynitride film in contact with a gas containing nitrogen to introduce at least nitrogen into the silicon oxynitride film;
- (c) after step (b), forming a semiconductor film containing an impurity of first conductivity type on the silicon oxynitride film;
- (d) after step (c), forming a gate electrode composed of the semiconductor film by patterning the semiconductor film; and
- (e) after step (d), forming a gate insulating film composed of the silicon oxynitride film by patterning the silicon oxynitride film.

Accordingly, by introducing nitrogen into the silicon oxynitride film comprising a gate insulating film, the nitrogen concentration within the silicon oxynitride film is increased and a nitrogen concentration distribution having a steeply sloped configuration is obtained. Another advantageous benefit in using silicon oxynitride film as a gate insulating film is that reduced threshold voltage can be prevented and a transistor having a superior ON/OFF property and a high driving force may be realized.

As the Examiner already knows “a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros. v. Union Oil Co. Of California*, 814 F.2d 628,

631, 2 USPQ2d 1051 (Fed. Cir. 1987). “The identical invention must be shown in as complete detail as is contained in the claims.” *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913 (Fed. Cir. 1989).

Initially, Applicant respectfully contends that the Office Action is improper since it finds that the *Hsu et al.* ‘889 patent anticipates base claim 1 without providing evidentiary support for the finding that the *Hsu et al.* ‘889 patent teaches each and every claim limitation set forth in claim 1. More particularly, the Office Action fails to consider all of the claimed features set forth in claim 1. In accordance with §2116.01 of the M.P.E.P., “all the limitations of a claim must be considered when weighing the differences between the claimed invention and the prior art when determining the obviousness of a process or method claim. *See* M.P.E.P. §2143.03. Interpreting the claimed invention as a whole requires consideration of all claim limitations. *Id.* “All words in a claim must be considered in judging the patentability of a claim against the prior art.” *In re Wilson*, 424 F.2d 1382, 165 USPQ 494 (CCPA 1970).

In this regard, the Office Action finds that the *Hsu et al.* ‘889 patent teaches a method of fabricating a semiconductor device comprising the steps of:

- (a) forming a silicon oxynitride film 21 on a substrate;
- (b) performing a heat treatment while keeping a surface of the silicon oxynitride film 21 in contact with a gas containing nitrogen to introduce at least nitrogen into the silicon oxynitride film 21; and
- (c) forming a semiconductor film 31 containing an impurity on the silicon oxynitride film 21.

It appears that the current rejection of claim 1 mirrors a rejection which was issued by the Examiner on January 19, 2001. In response to the January 19, 2001 Office Action which rejected claim 1, however, Applicant amended claim 1 to include steps (d) and (e), which are directed to forming a gate electrode composed of the semiconductor film by

patterning the semiconductor film; and forming a gate insulating film composed of the silicon oxynitride film by patterning the silicon oxynitride film, respectively. While the Office Action addresses steps (a)-(c) of claim 1, it fails to consider steps (d) and (e). Applicant respectfully request full consideration of every step set forth in claim 1.

This fact notwithstanding, Applicant respectfully contends that the *Hsu et al.* '889 patent fails to expressly teach or inherently describe each and every element set forth in claimed invention necessary to support a finding of anticipation under §102. For instance, the *Hsu et al.* '889 patent appears to disclose a method of forming a field isolation region by LOCOS oxidation, wherein the pad layer 21 composed of the silicon oxynitride layer and the silicon layer 41 are formed as a background film for the silicon nitride layer 42, which acts as an oxidation prevention mask during LOCOS oxidation. Accordingly, after forming the field isolation region 62, the pad layer 21 composed of the silicon oxynitride layer and the silicon layer 41 are removed and a new gate insulating film 82 and gate electrode 83 are formed.

The pad layer 21, however, is composed of the silicon oxynitride layer, and the silicon layer 41 acts neither as a gate insulating film nor a gate electrode respectively. Hence, the *Hsu et al.* '889 patent differs structurally from the claimed features of the present invention. In addition, the silicon layer 41 disclosed in the *Hsu et al.* '889 patent is only annealed in an inert gas, and does not include impurities of a first conductivity type, as presently set forth in claim 1 of the claimed invention. Hence, the silicon layer 41 disclosed in the *Hsu et al.* '889 patent differs from the features set forth in the claimed invention.

Moreover, the *Hsu et al.* '889 patent also fails to expressly disclose or inherently suggest a combination of forming a gate electrode composed of the semiconductor film by patterning the semiconductor film and forming a gate insulating film composed of the silicon oxynitride film by patterning the silicon oxynitride film, as set forth in steps (d)

and (e) in accordance with claim 1 of the claimed invention.

Accordingly, since the *Hsu et al.* '889 patent fails to expressly teach or inherently describe each and every claim limitation necessary to support anticipation under §102, Applicant respectfully requests reconsideration and withdrawal of the rejection.

The Office Action rejects claim 2 under 35 U.S.C. §103(a) as unpatentable over *Hsu et al.* '889 in view of *Sung* (U.S. Patent No. 6,040,216), claim 4 under 35 U.S.C. §103(a) as unpatentable over *Hsu et al.* '889 and claim 10 under 35 U.S.C. §103(a) as unpatentable over *Hsu et al.* '889 in view of *Gardner et al.* (U.S. Patent No. 6,144,071). Applicant respectfully traverses this rejection in asserting that the claimed invention sets forth features which are patentably distinct over the prior art of record at least for the following reasons. Reconsideration and withdrawal of the rejection is earnestly solicited in view of the following reasons.

The claimed invention in accordance with claim 2 discloses a method of fabricating a semiconductor device wherein a silicon oxynitride film is formed by concurrently applying an N₂O gas and performing a heat treatment to the surface of the silicon substrate.

Three criteria must be met to establish a *prima facie* case of obviousness. *M.P.E.P.* §2143. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings to achieve the claimed invention. *Id.* Second, there must be a reasonable expectation of success. *In re Rhinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976). Third, the prior art must teach or suggest all the claim limitations. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

Applicant respectfully contends that the *Hsu et al.* '889 patent, either alone or in combination with the *Sung* or *Gardner et al.* patents, fails to expressly teach or

inherently describe each and every element set forth in claimed invention necessary to support a finding of *prima facie* obviousness under §103.

Inasmuch as Applicant has shown that the base *Hsu et al.* '889 patent clearly fails to teach or disclose each and every feature of claim 1, whose subject matter claim 2 incorporates by reference, Applicant respectfully contends that the rejection of claim 2 is improper for the same reasons.


Even assuming, *arguendo*, that the base *Hsu et al.* '889 patent anticipates or renders claim 1 obvious, Applicant contends that claim 2 defines subject matter which is patentably distinct over the proposed *Hsu et al.* '889 combination. In particular, Applicant respectfully contends that there is a lack of motivation in the prior art of record to either modify the *Hsu et al.* '889 patent or combine the respective teachings of the *Hsu et al.* '889 and *Sung* patents in order to achieve the claimed invention. For example, the *Sung* patent discloses a method of fabricating a semiconductor device wherein silicon oxynitride 117 is formed by annealing in oxygen after nitrogen is introduced to a surface of an active region 111 during an ion implantation step by using N₂O and the like (*See*, Fig. 3). Therefore, the method of forming the silicon oxynitride 117 by oxidizing the nitrogen introduced active region 111 disclosed in the *Sung* patent is completely different from what is claimed in claim 2 of the present invention, notably, a step of forming a silicon oxynitride film by concurrently applying an N₂O gas and performing a heat treatment to the surface of the silicon substrate.

Accordingly, since the proposed *Hsu et al.* '889 combination fails to expressly teach or suggest all of the limitations set forth in claimed invention necessary to support a *prima facie* case of obviousness under §103, it is respectfully requested that the rejection be reconsidered and withdrawn.

In view of the foregoing comments, Applicant respectfully contends that the claimed invention is clearly patentably distinct over the prior art of record and that the

pending claims are in proper condition for allowance. Reconsideration of these claims in view of the above comments is respectfully requested. If the Examiner believes further discussions with Applicants representative would be beneficial in this matter, he is invited to contact the undersigned.

Respectfully submitted,



Eric J. Robinson
Reg. No. 38,285
Nixon Peabody LLP
8180 Greensboro Drive, Suite 800
McLean, Virginia 22102
(703) 790-9110

EJR/TAV